Journal of Public Health Research

eISSN 2279-9036 https://www.jphres.org/

J Public Health Res 2021 [Online ahead of print]

To cite this Article:
Rachmah Q, Martiana T, Mulyono, et al. **The effectiveness of nutrition and health intervention in workplace setting: a systematic review.** J Public Health Res
doi: 10.4081/jphr.2021.2312

The effectiveness of nutrition and health intervention in workplace setting: a systematic review

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Acknowledgement:

We would like to thank the Faculty of Public Health, Universitas Airlangga and Universitas Airlangga for the full support in writing this systematic review.

Funding: This publication receives no funding

Contribution: Qonita Rachmah, Tri Martiana, Mulyono, Indriati Paskarini, Endang Dwiyanti, Noeroel Widajati, Meirina Ernawati, Yustinus D Ardyanto, Abdul R Tualeka concepting the idea and research method; Qonita Rachmah, Dani N Haqi, Shintia Y Arini, Putri A Alayyannur write the manuscript; all authors revised the manuscript and approved the final version of the manuscript.

Conflict of Interest: The authors declare no conflict of interest.

Availability of data and materials: All data generated or analyzed during this study are included in this published article.

Ethics approval and consent to participate: not applicable

Significance for public health: This systematic review proved several nutrition and health intervention in workplace setting that resulting in improvement of healthy behavior, anthropometric and biochemical indicators. Further, nutrition and health intervention can be implemented in workplace as a way to increase work productivity, reduce the disease burden costs of employee, and improve general health status.

ABSTRACT

Introduction: Health status of workers are crucial to maintain their productivity and it will impact on output per capita. This systematic review aims to evaluate the effectiveness of nutrition and health intervention in workplace setting and implication for further research. **Methods:** Articles were searched from *PubMed, PMC, Cochrane Library (Trial), Science-direct,* and *Google scholar* published from 2005 – 2020. Inclusion criteria was the intervention subject aged 19 – 64 years old with experimental *randomized control trial (RCT)* or *non-RCT* study design. Several keywords used for literature searching including "nutrition education in workplace", "nutrition intervention in workplace", and "workplace intervention". Data were narratively described. **Results:** Eleven studies were meet inclusion and exclusion criteria and further be reviewed. Five studies focused on intervene food environment in the workplace, four studies focused on nutrition education using different channels i.e. workplace visiting and emails, the other two interventions were objected to decrease health risk regarding occupational health. Positive outcomes were recorded for all workplace intervention, including increase in nutrition knowledge, self-efficacy, reduce risky behavior, and also improved body mass index and blood biomarkers. **Conclusions:** Workplace nutrition and health intervention

proved to be an effective way to enhanced balanced nutrition behavior and improve health status. This study implies an urgency of nutrition and health intervention in a workplace.

Keywords: behavior, nutrition intervention, occupational health, workers, obesity

INTRODUCTION

Based on social determinant of health concept, workplace is one of the places that could affect wide range of health, functioning, and quality-of-life outcomes and risks[1]. It is strengthened by the WHO which described a workplace as a priority environment to influence dietary behaviors given that individuals can spend up to two-thirds of their waking hours at work[2]. Tompa in his publication revealed that health status could directly impact workers' productivity which can be measured using output per hour worked, output per paid labor hour, output per worker, and output per labor force participant[3]. In the end, those level of workers' productivity will impact on output per capita as a measure of standard living. A potential health problem among workers are work accident, occupational illness, non-communicable diseases and communicable diseases[4]. A good health status not only impact on individual but also for the workplace itself. Several strategies that could be used for improving workers' productivity including improving nutrition, sanitation, education, health promotion, healthy workplace, occupation-health and safety, and population health.

Indonesia's latest national survey in 2018 reported the highest non-communicable diseases among productive age was hypertension, followed by stroke, joint diseases, cancer, and diabetes. Moreover, 35.4% of adults reproductive age are overweight/obese[5]. Overweight/obese found to be the dominant factor of metabolic syndrome which defined as metabolic disruption including hypertension, type 2 diabetes, central obese, high triglyceride level and low HDL cholesterol level[6]. American College of Occupational and Environmental Medicine (ACOEM) explained that the workforce supports the financial underpinnings of healthcare system and drives the country's economy. Thus, building a preventive-based strategy to enhance workers' health and productivity is a crucial investment[7].

Workplace nutrition intervention had the highest positive effect on health behaviors as mentioned by The American Heart Association [8]. Further, AHA also describe a guideline of workplace nutrition intervention including the use of well-balanced meals (low-fat dairy products, low saturated fat and avoiding trans-fat, more fruits and vegetables, whole grains, seafood, lean meats and poultry, as well as salt alternatives. At least two studies revealed that workplace nutrition intervention bettered workers' diet and physical activity which could decrease the risk factor of cardiovascular diseases[9,10]. Moreover, Hochart & Lang mentioned that nutrition education program in worksite able to increase work efficiency, lowering absenteeism and employees' healthcare cost[11]. Hence upon, a behavior enhancing nutrition and health status of the workers should be implemented in every workplace. Further implication on the emergence of health and nutrition intervention in a workplace need to be assessed. To our knowledge, currently there are not many systematic reviews that focus on nutrition education in the workers, but focuses on vulnerable age groups such as school children, adolescents and pregnant women. In results, not many companies or small to medium enterprises (SMEs) that having nutrition and health education as their primary policy. Thus, this study aims to review the efficacy of health and nutrition intervention among workers that result can be used as the evidence based for policymakers to start implementing health and nutrition education periodically.

METHODS

Articles were searched from five electronic databases i.e. *PubMed, PMC, Cochrane Library (Trial), Science-direct,* and *Googlescholar.* An online search was conducted in March 2020 for all intervention articles on workers published in 2005 – 2020. Several keywords used for literature searching including "nutrition education in workplace", "nutrition intervention in workplace", and "workplace intervention". This study did not limit the outcomes presented by the authors in the articles found. Figure 1 presenting the article search flow chart.

Inclusion and exclusion criteria

The literature review aims to answer research questions "how is the effectiveness of interventions carried out in a workplace setting?". Studies to be included in this review

had to match predetermined criteria according to the PICOS approach. Criteria for inclusion and exclusion are specified in Table 1.

Table 1. PICOS criteria for inclusion and exclusion of studies.

Parameter	Inclusion criteria	Exclusion criteria
Patients	Workers in company or small to medium enterprises (SME)	Not a worker
Intervention	Diet intervention, physical activity intervention, or health-related intervention	
Comparator	How effective are the different treatment methods	
Outcomes	Health-related outcomes	
Study design	Experimental research; with or without control group	Observational studies, literature studies, meta-analysis, comments, short communication, editorial letters and non-English articles

Data Extraction and Data Synthesis

Five electronic databases were searched up until March 2021. Key words identified studies intervening to improve nutrition-related outcomes for industrial workers. Two reviewers worked independently of each other to assessed articles independently for inclusion and study quality and extracted data. Only studies published in English were included. Data were summarized narratively. There was no disagreement between two reviewers.

RESULTS

Study selection

Initially, we subsequently screened 870 titles and abstracts described about workplace intervention through different electronic databases including *PubMed, PMC, Cochrane Library (Trial), Science-direct,* and *Google scholar.* Of these, 775 were excluded due to uncorrelation with nutrition and health topic and/or published less than

year 2005. We assume that a study longer than 2005 might be not suitable with recent conditions. Then, full text paper of 45 articles were following next review. Thirty-six articles were excluded due to the following reasons: non-experimental study or cross-sectional study, reviews, and unrelated studies. Thereafter, the full texts of 11 studies were assessed for eligibility and included in this systematic review.

Study characteristics

All 11 included studies were experimental study, eight studies using control-group and another two did not measure the control group[12-15;17-22]. All of intervention study reviewed were able to prove the positive outcome of workplace nutrition and health intervention. Minimum duration taken for experiment study in workplace setting was 8 weeks (or 2 months) and the longest period of intervention was 3 years. This review included 11 articles from 11 different countries including South Korea, Iran, Bangladesh, Taiwan, Spain, the United States, Cambodia, Denmark, Canada, Brazil and Ireland. The most prevalent measurable outcomes were knowledge, behavioral change related to nutrition and physical, body mass index and several anthropometric and biochemical measurements. Ten studies assigned workplace's employees as the participant and only one study in which respondent was cafeteria manager. Most of the study measure behavioral outcome as it could last longer and maintain the respected behavior in workplace. Based on the type of intervention, there were four different type of nutrition and health intervention in workplace namely education and behavioral change program, meal intervention, exercise intervention and a combination of several intervention. Table 2 showed the details of each study.

Table 2. Summary of the impact of nutrition and health interventions in workplace setting

Reference	Study design (S)	Patients (P)	Intervention group (I)	Control group ©	Intervention Duration	Outcome (O)
Kim, H. J et al. (12)	Not stated	75 male workers of L company	Workplace-visiting nutrition education program; Each educational session was carried out for 20 minutes and subjects received consulting 2 times on average	No control group	4 months	Significant decreases in body mass index ($p < 0.05$), fasting blood sugar ($p < 0.01$), total cholesterol ($p < 0.05$), and LDL- cholesterol ($p < 0.05$) after nutrition education.
Hassani, B et al. (13)	Randomized controlled field trial	104 employees with dyslipidemia	Five training sessions were aimed at avoiding the intake of trans-fats, using less saturated fats and simple carbohydrates, increasing the consumption of fruits/vegetables and whole grains while highlighting the importance of breakfast and healthy snacks through educational classes at work. Educational content was de- livered through lectures, question/answer sessions and group discussion. At the end of each session, a package of healthy snacks was distributed. N=49	Did not receive nutrition education N = 43	3 months	The education group significantly improved their nutritional knowledge ($p < 0.001$), dietary intakes ($p < 0.005$), serum FBS ($p < 0.001$) and Hcy levels ($p < 0.001$) and anthropometric indices.
Hossain, M et al. (14)	A quasi-experimental mixed method study	1310 non-pregnant female RMG workers from four factories.	(A) Lunch meal intervention package: daily nutritionally-enhanced (with fortified rice) hot lunch, once weekly iron-folic acid (IFA) supplement and monthly enhanced (with nutrition module) behavior change counseling (BCC) versus (B) Lunch meal control package: regular lunch and BCC; and (C) Non-meal intervention package: twice-weekly IFA and enhanced BCC versus (D) Non-meal control package: BCC alone.	(A) Lunch with regular rice and regular behavior change counseling (BCC) (B) Regular BCC only	10-months	Anemia was reduced significantly in both lunch meal and non-meal intervention (A and C) group (DID: 32 and 12 percentage points, p: <0.001 and <0.05 respectively). The mean hemoglobin concentration also significantly increased

			N = 326	N = 328		by 1 gm/dL and 0.4 gm/dL in both A and C group (p: <0.001 respectively). Weight did not change in the intervention groups (A and C) but significantly increased by more than 1.5 kg in the comparison groups (B and D).
Shih, CK, et al. (15)	Open-label, randomized, parallel dietary intervention trial	58 white-collar workers	The WSP-MR group was advised to replace two daily meals, namely lunch and dinner, with two packs of shakes and one normal diet meal. The participants received a daily serving of two packets with 132 g of WSP-MR formula (21 g of WSP from 66-g packets). In each packet, 400 mL of warm water was added to provide heat density of 0.65 kcal/mL for each meal. N=30	Normal diet daily (non-WSP group) N=30	8 weeks	After eight weeks, body weight, body fat, body mass index, wrist circumference, thigh circumference, calf circumference, mid-arm circumference, and triceps skinfolds decreased significantly in both the groups. Moreover, the WSP-MR group demonstrated a 5% decrease in body weight, body fat, body mass index, and mid-arm circumference and a 3.5% decrease in glycated hemoglobin levels ($p < 0.05$).
Gómez-Recasens, M et al. (16)	Non-randomized, single-group study	1103 workers	All employees received 5 h of training in methods designed to change behaviors and reduce alcohol and drug consumption through the active encouragement of participants in discussions of real cases	No control group	3 years	The prevalence of risky alcohol consumption decreased by 4.1% (baseline: 14.7% reduced to 10.6% in the first year; $p = 0.001$)

Peters, SE et al. (17)	A matched-pair cluster randomized controlled trial	607	Five intervention groups The ARM intervention contained two main intervention components: (1) the Soft Tissue Injury Prevention Program (StIPP) which focused on improving ergonomics practices at the site and worker level to improve musculoskeletal health; and (2) Health Week, that integrated key messages and provided integrated health coaching opportunities for individual workers to improve ergonomic practices and improved health behaviors (diet, physical activity, and smoking) associated with cardiovascular health. (N=283)	Five control groups (no intervention) N=324	6 months	There was a difference in favor of the intervention group for a reduction in physically demanding work (B = −0.25, p = 0.008), increased recreational physical activity (B = 35.2, p = 0.026) and higher consumption of fruits and vegetables (B = 0.87, p = 0.008).
Makurat, J et al. (18)	Exploratory randomised controlled trial	158 female Cambodian garment workers	Providing adequate full lunch sets (consisting of a stir-fried dish, a soup, a side item (cooked rice), and a fruit dessert) with total roughly 700 kcal (one-third of RDA)	No intervention	6 months	Lunch provision resulted in a higher consumption rate of vitamin A-rich fruits and a lower intake frequency of sweets, lunch provision had a less clear impact on total 24-h intake from different food groups and was not associated with a higher women's dietary diversity score (WDDS)
Zebis, M.K et al. (19)	Cluster-randomized controlled trial	537 industrial production units	Intervention group receiving high-intensity strength training for the neck and shoulders three times a week (n = 282)	Control group receiving advice to stay physically	20 weeks	In the training group compared with the control group, neck pain intensity decreased significantly (-0.6, 95% CI -1.0 to -0.1) and shoulder pain intensity

				active (n = 255).		tended to decrease (-0.2, 95% CI -0.5 to 0.1, P = 0.07).
Plotnikoff, R. C et al. (20)	A pre- and post-test design	2121 employees	The intervention group received one physical activity and one parallel nutrition message per week for 12 weeks. N=2121	The control group received no weekly messages. N=555	12 weeks	The intervention group was more efficacious at time 2 on measures of self-efficacy, pros, cons, intentions, and behavior related to physical activity. This group also reported more favorable changes in practicing healthy eating, balancing food intake with activity level, cooking meals with techniques to reduce fat, and avoiding eating high-fat foods.
Bandoni, et al. (21)	Randomized intervention study	Twenty-nine companies and 2510 workers.	The intervention was performed in four consecutive stages and addressed aspects of menu planning, food presentation, motivational strategies to encourage the consumption of fruits and vegetables, and a focus on changes in the work environment. The managers of the cafeterias participated in all stages of the intervention.	No intervention	6 months	An average increase in the availability of fruits and vegetables of 49 g in the intervention group, an increase of approximately 15%, whereas the results for the control group remained practically equal to baseline levels. During the follow-up period, the intervention group also showed reduced total fat and an increase in fibre in the meals offered. The results

						showed a slight but still positive increase in the workers' consumption of fruits and vegetables (about 11 g) in the meals offered by the companies.
Geaney, F et al. (22)	A cluster-controlled trial	Four large, purposively selected manufacturing workplaces	Three different intervention i.e. nutrition education (Education) (N = 226), environmental dietary modification (Environment) (N = 113) and nutrition education and environmental dietary modification (Combined) (N = 400)	No intervention	9 months	There were significant positive changes in intakes of saturated fat (p = 0.013), salt (p = 0.010) and nutrition knowledge (p = 0.034) between baseline and follow-up in the combined intervention versus the control. Small but significant changes in BMI (− 1.2 kg/m2 (95% CI − 2.385, − 0.018, p = 0.047) were observed in the combined intervention.

Education and behavioral change program

Five studies were focus on giving education and behavioral intervention with different approach and time frame. A study in South Korea providing a nutrition counseling for male workers for 4 consecutive months. Nutrition education was conducted in a self-directed coaching method, anthropometric and biochemical assessment was done before counselling session, as well as dietary habits. Each worker visited 2 times with 20 mins for each session. Mean intake during intervention was 2160 kcal of energy, 321.3 gr of carbohydrate, 79.7 gr of protein, and 61.8 gr fat (ratio 60:15:26), 15 gr of fiber. This study results a significant decrease in body mass index, fasting blood sugar, total cholesterol and LDL-cholesterol after nutrition education[12]. Aligned with previous study, Hassani B et al. also observed an increase in nutritional knowledge, improved dietary intakes, fasting blood glucose and homocysteine levels after 3 months educational workshop intervention[13]. This study was done in five training sessions focusing on the limitation of trans-fats, saturated fats and simple carbohydrates, increasing the consumption of fruits/vegetables and whole grains while highlighting the importance of breakfast and healthy snacks through educational classes at work. Educational method used in this study including lectures, question/answer sessions and group discussion.

Longest workplace intervention in this review was 3 years, done in 12 work centers in Spain started in 2009. The study emphasized on health promotion and health monitoring, which included alcohol and drug awareness and the evaluation and monitoring of alcohol and drug consumption. Each worker given 5 hours awareness training session. This study was done considering high intake of alcohol and drugs among workers could increase risk of work accidents, absenteeism, work incapacities and decreased productivity[24]. After intervention and close monitoring, positive result shown at the first year after intervention where the number of risky alcohol consumption was decrease and keep reducing over 3 years follow up[17]. A different intervention approach for education program was done in Brazil. Instead of the workers, cafeteria's managers were educated to change the food environment in 29 companies for 6 months. This intervention succeeded to increase fruits and vegetable availability up to 49 gr, while no

change in control group and also gives a positive result in increasing fruits and vegetable for 11 grams[22].

Another nutrition education in a workplace context was done using email. The intervention group received one physical activity and one parallel nutrition message per week for 12 weeks; while the control group received no weekly messages. Several messages sent through employee's email were active living, balanced nutrition, increase fruits and vegetable intake also reduce fat intake. The email-based intervention study proved to increase worker's self-efficacy in healthy eating habits and physical activity[21].

Meal and/or supplement intervention

There were three intervention in a workplace focusing on meal and/or supplement intervention. An RCT dietary intervention trial by giving meal replacement made from white sweet potato for lunch and dinner, added two packs of shakes. In this intervention, all workers were also instructed to restrict daily energy intake up to 1200 kcal for women and 1500 kcal for men. After eight weeks of intervention, both intervention and control group showing a decrease of body weight, body fat, body mass index, wrist circumference, thigh circumference, calf circumference, mid-arm circumference, and triceps skinfolds, but intervention group resulted higher decrease than the control. In addition, the intervention group with meal replacement resulted a decrease in glycated hemoglobin levels which could reduce the risk of type 2 diabetes. This study able to showed a significant result due to the high compliance of the workers[15]. Ferrara[16] described that adherence on meal replacement program might influence by individual self-efficacy, outcome expectations, and social communication.

Hossain, et al. did a quasi-experimental mixed method study among female workers by providing lunch meal, iron-folic acid supplement as well as behavior change counseling[14]. After 10 months of intervention, the mean hemoglobin and anemia was decreased significantly in both lunch meal and non-meal intervention, but no change in weight. Lunch meal provided for the intervention group consist of green leafy vegetables, lentils, fortified rice, fortified oil, and iodized salt every day and flesh foods at least three times a week. Another RCT among female garment workers that was done by providing lunch set (stir-fried dish, a soup, a side item (cooked rice), and a fruit dessert). The lunch was given for six months with total approximately 700 kcal in the canteen using local

Cambodian food. Lunch provision for female workers proved to increase intake of vitamin-A rich fruits, dark green leafy vegetables, oil and fats; but contrary lowering the intake of flesh meats, legumes, nuts and seeds, and sweets[19].

Exercise intervention

One cluster-RCT intervention in a workplace setting known to have focused on worker's physical activity. An intervention was focused for production unit employees whose having high prevalence of neck and shoulder pain. This study involving 537 workers implement 20 weeks of high-intensity strength training for the neck and shoulders three times a week (each 20 minutes) for a worker with high prevalence of neck and shoulder pain. Strength training was introduce by the Experienced instructors before conducted by the workers. High intensity training program shown in figure 1. High-intensity strength training relying on principles of progressive overload can be successfully implemented at industrial workplaces, and results in significant reductions of neck and shoulder pain compared to control group without training[20].

Combination of several intervention

The last two out of eleven studies in this review focusing mixed intervention[18,23]. A matched-pair cluster randomized controlled trial on commercial construction sites called All the Right Moves (ARM) intervention. The ARM intervention contained two main intervention namely the Soft Tissue Injury Prevention Program (StIPP) which focused on improving ergonomics practices at the site and worker and Health Week that integrated key messages and practices and improved health behaviors (diet, physical activity, and smoking) associated with cardiovascular health[18]. The ARM intervention managed to reduce physically demanding work, increase recreational physical activity and also increase consumption of fruits and vegetables. The other RCT study targeting four different workplaces undergone three different intervention namely nutrition education, environmental dietary intervention, and combination of both for 9 months. Better results were shown by the combination group; in which improving saturated fat and salt intakes, increase nutrition knowledge, also body mass index[23].

DISCUSSION

The results of this review showed that the intervention given in a workplace setting in the form of nutrition and health education, meal and/or supplement replacement, physical activity and combination type of intervention all gives a positive outcome. Several positive outcomes proved by several studies in this review including improved nutrition knowledge, improvement of anthropometric indices (decrease body mass index, body fat, wrist circumference, thigh circumference, calf circumference, mid-arm circumference, triceps skinfolds), improvement of biochemical indices (fasting blood sugar, HbA1C, total cholesterol level, LDL-cholesterol level, hemoglobin level), reduce risky behavior (alcohol intake, salt, saturated fat), increase dietary diversity score, higher intake of fruits and vegetables as well as fiber and vitamin A, elevate self-efficacy of doing physical activity and balance eating, reduction in physically demanding work and increased recreational physical activity, decreased neck and shoulder pain intensity[12-15;17-22].

Most of the studies undergone in this review employed a large sample size, thus, able to showed a significant change. Only two studies out of 11 that employed less than 100 respondents (75 vs 58, respectively)[12,15]. Similarly, the absence of comparison/control group were shown in two out of 11 studies although those two studies mentioned still able to captured a significant results of workplace intervention[12,17]. However, the use of control group in intervention study could better the study design since it could minimize biases and variability of factors that may influence intervention trial outcomes the bias of intervention effect[25].

The success of one intervention in twenty-nine workplaces is not only mainly due to the change of food environment by modifying fruits and vegetable availability but also combining with the advertisement of health food and involving workers in meal planning and management [26,27]. To date, changing the workplace environment still offered a great potential for promoting healthy nutrition[28]. It is again supported by the result of Gaeney, et al. study among manufacturing workplaces that proved a positive outcome from environment modification after 9 months. Environmental dietary modification included five elements: (a) menu modification: restriction of saturated fat, sugar and salt, (b) increase in fiber, fruit and vegetables, (c) price discounts for whole fresh fruit, (d) strategic positioning of healthier alternatives and (e) portion size control[29]. Other

environment intervention was repositioning certain healthy foods within the canteen i.e., confectionary products were replaced with healthy snacks (fresh fruit, dried fruit, natural nuts) by the cash registers. The environment modification combined with nutrition education focused on with aim focused on how they can make a healthy food choice within a modified workplace environment. Those study revealed a significant positive changes in intakes of saturated fat, salt and nutrition knowledge between baseline and follow-up in the combined intervention versus the control. Small but significant changes in BMI were also observed in the combined intervention[29].

It is further described that improvement of fasting blood sugar after a nutrition intervention might be mediated by the higher intake of fiber and low glycemic index food, with overall control on energy intake and body weight[30]. However, this study did not mention the pre and post intervention intake, thus we cannot conclude the causation between nutrition education intervention and blood glucose improvement. Another study using email-based nutrition education in weekly basis for twelve weeks able to increase worker's self-efficacy in healthy eating practice and physical activity. In addition, self-efficacy is an important factor to build a better nutrition behavior based on social cognitive theory[31]. It is explained that E-mail–based health interventions hold particular promise because they could reach large numbers of workers and can provide immediate feedback to participants[21]. Although, computer literacy of the workers might be an important issue to address this email-based intervention[32]. To our knowledge, email-based nutrition intervention is easier to carry compared to other intervention, also does not need many resources such as manpower and money, and able to reach out many employees, therefore, it is possible to be carry out in many workplace settings. A newly published review also concerned the use of digital technology might be beneficial to increase worker's physical activity and decrease sedentary behavior in the workplace setting[33].

Another type of nutrition intervention carried out is meal replacement. Meal replacement defined as portion and caloric controlled meals which suitable to use for overweight people in controlling the calorie intake[34,35]. Environmental change especially food environment could benefit the health of employee and lower the risk of non-communicable diseases. Another six studies also demonstrated the intervention was done in working environment. Hossain, et al. study among female workers was claimed as the

first nutrition intervention study in Bangladesh conducted, which showed the effectiveness of a combination of interventions to reduce anemia[14]. Micronutrient-fortified rice given to the female workers can be a significant source of dietary bioavailable iron that improved hemoglobin level[36]. The positive results of the study imply the continuation of the program especially for female workers to reduce the burden of anemia with minimum 10 weeks of supplementation, nutritionally-improved lunch meal, and education. Decrease intake of flesh meats might not be beneficial for the female workers considering the important role of iron for woman in reproductive age. The quantities of lunch meal given might have not been sufficient to meet the RDA for iron as reported for Cambodian women in rural areas[37].

Lastly, physical activity intervention in our review able to showed a better profile on neck and shoulder pain since the workers were in high risk of neck and shoulder pain[20]; another one RCT; the Soft Tissue Injury Prevention Program (StIPP) which focused on improving ergonomics practices at the workplace proved to reduce physically demanding work and increased recreational physical activity[18]. Both studies given an intervention based on the worker's need, considering the type of work that might worsen their health status. Therefore, further study focusing on physical activity intervention should also do an initial assessment to determine the need of the workers. A study among employees from different workplace setting in Australia revealed that working hours were mostly spent sedentary (77.0%) which could bring potential health risk burden[38]. Previous study revealed that strategy such as standing meetings could be used to reduce sitting hours in a workplace setting; however, several barriers were identified in applying those strategy such as workload pressure and workplace social norms[39]. Furthermore, a meta-analysis of workplace physical activity intervention describes several positive effects of workplace physical activity intervention including physical activity behaviour, fitness (VO_2max), anthropometric measures, work attendance, and job stress (0.33)[40]. Beyond it health benefits, promoting physical activity and reducing sedentary activity also promote social, mental, and economic domains which benefits organization itself[41]. Consequently, it is urge to do physical activity intervention in a workplace setting.

A publication in 1986 have not been prove the long-term benefit of nutrition intervention to change behavior or improve health[42], but our review found that nutrition intervention is now prove to improve both behavior and health such as practicing healthy

eating (more fruits and vegetable, less saturated fat/high fat food), balancing food intake with activity level, and reduce alcohol intake. This review proposed the development of research and science which prove both short and long-term benefit of nutrition intervention. In addition, another review[43] suggests the success of nutrition intervention in the worksite should pay attention to appropriate design and theory, focus on ≤3 objectives; duration more than equal to 5 months; whereas in our study, 4 studies were done <5 months, but mostly have ≤3 objectives and all resulting in positive outcomes.

Similar to our review, Robroek[44] also conclude that a review related to worksite health promotion programmes is essential to developed a specific health programmes based on each worksite needs. Nevertheless, an effort to increase workers participation need to be considered because of their low participations. Another review that in line to our study suggest that diet-related workplace interventions have positive effects on workers' nutritional knowledge, food intake and health, increase productivity, reduced absenteeism and presenteeism[45].

We note some strength in our study including the variety of health and nutrition intervention that resulting in positive health outcome ranged from anthropometric change to biochemical change and also most importantly, behavioral change. This systematic review can be used as the material to advocate nutrition and health interventions in the office. However, some limitations are also followed, i.e., risk of bias strategy was not present. Reviewers was assessed articles included using PICOS strategy only. Other than that, we only consider articles that were published in English, so that, there is a possibility that some recent and important findings published in languages other than English were left out.

A short- and long-term benefits of nutrition and health intervention in the workplace suggests the importance of its implementation specially to improve employees' productivity and reduce burden cost. Therefore, our review can be used by the company to start and tailored nutrition/health intervention. In the bigger level, it can be used for policy makers to develop regulations that require all companies to carry out nutrition / health interventions.

CONCLUSION

In conclusion, this review imply that workplace may provide an optimal setting to reach a large proportion of the adult population thus could improve both nutrition literacy and practice as well as health status. Workplace interventions related to nutrition, physical activity, and health reviewed in this paper all gives different positive outcomes from knowledge and self-efficacy elevation, behavior change especially in increasing fruits and vegetable intake, reduce fat intake, avoiding alcohol and drug consumption, and starting a balanced nutrition habit. Moreover, workplace intervention could also address ergonomic related work problem considering the health problem that might arise among workers. Comparing different type of intervention studies, a combination of education-behavioral change program and work environment modification seems to results better outcome. Modify the future research by focusing on matching workers' needs in terms of nutrition and health behavior might be done to benefit the industry. Moreover, assess the population with high-risk nutrition problem in the workplace might also needed to focusing the nutrition intervention program.

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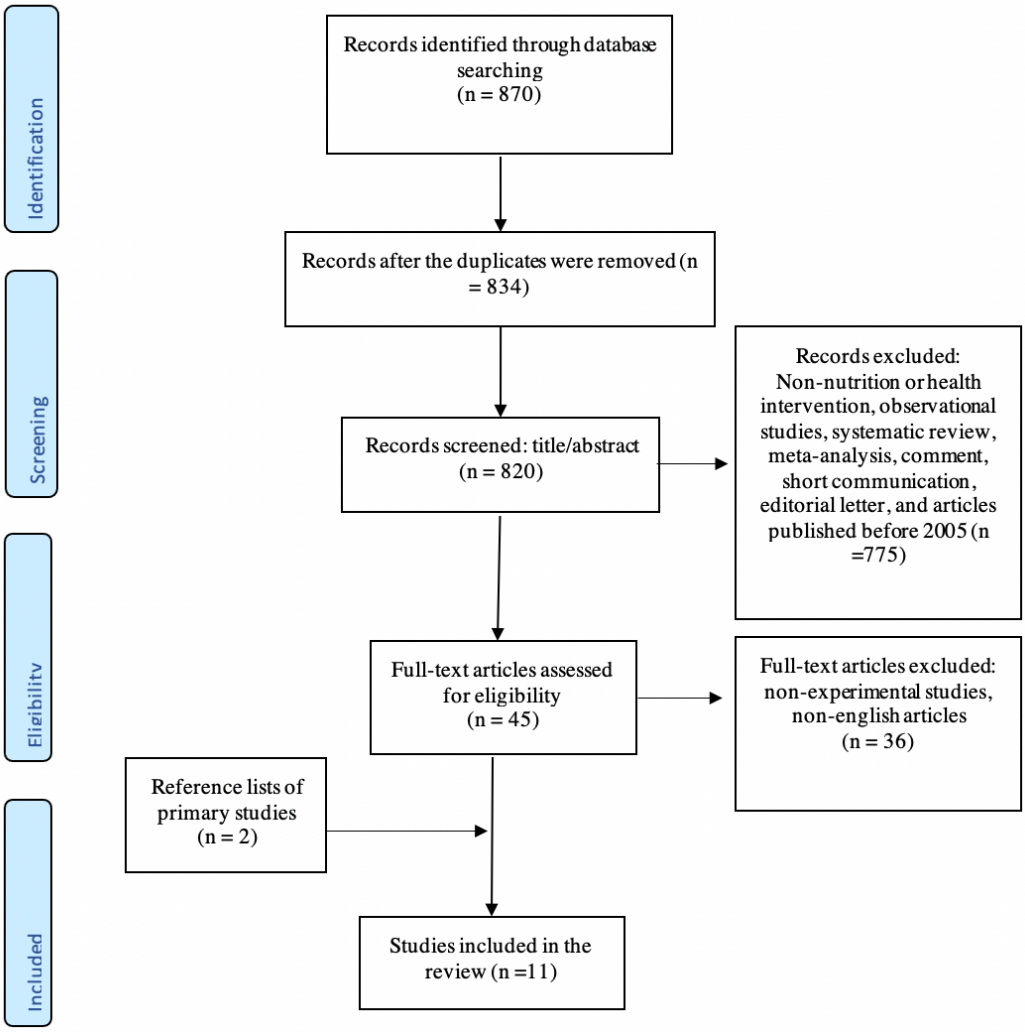

Fig 1. PRISMA flowchart of studies included and excluded at each stage of screening